2:00pm, Saturday, Nov. 15, Evans Hall

Room 10

APS-AAPT Roles in the World Year of Physics

Chuck Stone
North Carolina A&T State Univ.
cstone@ncat.edu

The year 2005 has been designated the World Year in Physics(WYP) to commemorate the 100th anniversary of Albert Einstein's papers on quantum theory, Brownian motion, and special relativity, first published in 1905. Organizations around the globe are planning a variety of programs to raise worldwide public awareness for physics in 2005. The APS will orchestrate the lead program for the United States. This presentation will discuss the WYP and describe activities, ideas, and resources that APS and AAPT members can use to contribute to the success of this international campaign.

Room 60

Physics 7: A Successful Reformed Research-Based Intro Physics Course

Patrick Hession
University of California, Davis
Hession@physics.ucdavis.edu

We have totally changed our large introductory course taken by biological science majors at the University of California, Davis. The implications of a constructivist understanding of how students learn is at the core of both the original inception of the course in fall 1996 and its more gradual evolution since, based on continuous formative assessment. To date, some 10,000 students have enrolled in the course. Summative assessments based on student performance in a follow-up physiology course show that Physics 7 students have a relatively large and statistically significant grade advantage in the subsequent physiology course, compared to those who took a traditional physics course at UC Davis or elsewhere. (See Friday talk by Potter.) (...)

Room 9

The Flying Pig

Paul Robinson
San Mateo High School
laserpablo@aol.com

Circular motion is a special case of something moving at a constant speed while the direction continually changes. For anything moving in a circle, the net force on it is always inward towards the center of the circle. Most vehicles employ friction to make turns. Hence roads are often banked to minimize the needed friction. Airplanes bank in the direction needed for turning. In all such cases the net force is directed radially in the plane of circular motion. A Flying Pig is a delightful example of conical pendulum for which the horizontal component of the tension is mv^2/r. Student data verify this relationship usually within a few percent.

Room 3

Forcing Reactions to be Efficient: Single-Molecule Studies of Transcription

Nancy Forde
UC Berkeley
nforde@alice.berkeley.edu

The cell can be viewed as a microscopic factory, where machinery actively moves, sorts, synthesizes and degrades biological material. Many of these cellular machines operate mechanically, generating forces accompanying their unidirectional movement; they can be considered molecular motors, converting chemical energy into mechanical work. We are studying mechanical aspects of transcription, a central process in the cellular cycle in which an RNA molecule is synthesized to make a copy of DNA. This reaction is catalyzed by the enzyme RNA polymerase, a molecular motor that can generate considerable force as it "walks" along the DNA template. We use a combined laser tweezers - flow control instrument to apply force to individual transcribing complexes, monitoring the action of a single RNA (...)

Room 70

Attenuation of the Visible Electromagnetic Spectrum at Avila Bay, California

Darren Fraser
Cal Poly Physics
dfraser@calpoly.edu

We have measured attenuation characteristics of the visible electromagnetic spectrum in half meter increments to 10 meters below the ocean surface. Attenuation characteristics are measured from 400 to 700 nm in 2 nm increments. We find our data to be exponential in nature and are able to derive attenuation coefficients as a function of lambda, yielding an absorption profile of the ocean water. This study is site sensitive and because of that all data were taken a half-mile out on the Unocal-Cal Poly Pier at Avila Beach. Our end goal is to understand how light and electromagnetic energy attenuates with depth in the ocean.

Room 2

Quantum Cosmology and Interfering Topologies

Steven Carlip
UC Davis
carlip@dirac.ucdavis.edu

The "no boundary" initial condition for the Universe, proposed by Hartle and Hawking and popularized by Hawking, suggests that our Universe arose as a quantum fluctuation from "nothing." As in any quantum process, different amplitudes can interfere with each other. I describe recent results suggesting that amplitudes coming from different spacetime topologies can interfere constructively, resulting in sharp peaks in the wave function of the Universe centered on homogeneous spatial geometries. While these results are unlikely to replace cosmic inflation as an explanation for the homogeneity of the Universe, they may fill in an important gap – the open problem of how to get the initial homogeneous patch required to start inflation.

2:20pm, Saturday, Nov. 15, Evans Hall

Room 10

Is Much of Mathematics Really Part of Physics?

Meinhard E. Mayer
University of California, Irvine
mmayer@uci.edu

Every physicist knows how important mathematics is in theoretical physics and Wigner has written about the "Unreasonable effectiveness of mathematics in physics." Less emphasized is the degree to which physics has influenced the development of mathematics. I will present a few examples to illustrate this point, hopefully at a level accessible to a wide physics audience.

Room 60

Organization of Content in Physics 7 at UC Davis

Mark McKinnon
University of California, Davis
mckinnon@physics.ucdavis.edu

Both research and personal teaching experience tell us that students often fail to develop an understanding of the connections between topics within an introductory physics course as well as to everyday understandings and to content in other disciplines. This is addressed in Physics 7 by replacing physical-phenomena centered topics as a key organizational element with broadly applicable "models." These models emphasize the commonalities between various physical phenomena rather than the differences. This approach also allows us to address another serious reform issue: there is simply too much material presented in a one-year course for typical students to achieve functional understanding of even a small fraction of the material. But which topics can be eliminated? (...)

Room 9

Sneaking Math into Physics – Under Cover of Data

Tim Erickson
AAPT
tim@eeps.com

In our NSF-sponsored project, we're incorporating more data analysis into physics labs and problems. This, alas, needs math. Furthermore, students often do not recognize the math they already know when they first see it. Yet by (a) getting technological help with visualization and (b) focusing both on the conceptual, physical meaning of the data and on its specific connection to the mathematics (e.g., the meaning of a slope in a context), students improve their grasp of both the physics and the mathematics.

Room 3

Probing the Electroweak Force with SLAC E-158

Brock Tweedie
UC Berkeley
brock@socrates.berkeley.edu

Electroweak theory has become the cornerstone of modern particle physics, serving dual roles as a reliable predictive framework for a wide class of phenomena (e.g., all of electromagnetism) and as the standard against which new theories must be tested. The past decade has witnessed the birth of "precision" electroweak physics, wherein high statistics data and careful experimental techniques are pinning down the exact parameters of the theory and testing progressively more refined predictions calculated from it. The hope shared by most particle physicists is that electroweak theory will be pushed past the point of its validity, revealing a new level of particle interactions and a deeper understanding of nature. I will discuss (...)

Room 70

Student Research Project: A [SII] survey of the Rosette Molecular Cloud

Jason Ybarra
California State University, Sacramento
jybarra@csus.edu

A newly forming protostar produces outflows from its axis of rotation. When these outflows interact with the surrounding medium, regions of high temperature shocked gas radiate light at emission line wavelengths such as [SII], [OIII], and Ha. Forbidden line [SII] and off-line continuum CCD emission line imaging data have been obtained for the Rosette Molecular Cloud (RMC) region. Our images reveal several [SII] emission features in and around previously identified embedded star clusters. Spatial coincidences between the emission features and star forming regions within the cloud will be discussed.

Room 2

Why Einstein's Relativity is Relevant to Quantum Computation

A. C. Manoharan
California State Univ. Stanislaus
manoharan@att.net

When Feynman introduced quantum computation, it was based on non-relativistic quantum mechanics. But Einstein's special relativity as well as quantum theory, were well established experimentally as the two great physics revolutions of the twentieth century. In fact the theory of light and electrons ("qed"), "the most accurate theory known to man," as Feynman put it, has led to quantum field theory, which is a logical edifice built on relativity and quantum mechanics. There were beautiful highlights like the award-winning essay by Eliezer on the nature of light, the discovery of the Lamb shift and its calculation by Bethe and Schwinger. By looking at quantum computation with relativity, many new approaches to physics and computation become practically possible. Some of the limitations of Turing computation are also overcome. I will discuss (...)

2:40pm, Saturday, Nov. 15, Evans Hall

Room 10

Some Questions I would like to ask Feynman, Wheeler, Weinberg, Hawking, Thorne, Penrose, Guth, Glashow, or Gell-Mann.

Lewis Epstein

retired from City College of San Francisco

laserpablo@aol.com

College and high school teachers need some serious help understanding post modern physcis. I will give specific examples.

Room 60

The Discussion/Lab Experience in Physics 7 at UC Davis

Jacob Blickenstaff

School of Ed, University of California, Davis

jblicken@ucdavis.edu

The heart of the student experience of physics in the reformed Physics 7 course at UC Davis is the five-hour per week discussion/lab. The fundamental principle driving the design and evolution of what is done in DL is that students must make sense of new ideas by relating them to what they already know. This happens through students active engagement, so cooperative group work and whole class discussion are key features of DL. Typically a concept will be covered in four parts: 1st 45 minute activity introduces a new concept or representation, 2nd 45 minute activity provides practice with new concept or application. Homework on concept, representations, or applications. At the following DL meeting: 3rd 45 minute activity-involving follow-up of homework. The materials (...)

Room 9

A Conceptual and Diagrammatic Method of Introducing Motion in Introductory Physics

Dennis Albers

Columbia College

albersbus@earthlink.net

We have been using for seven years a method of introducing students to motion that uses no formulas, yet allows students to solve quantitative motion problems. The method turns on two things: (1) a new kind of motion diagram that is quantitative and (2) the requirement that students use only their base understanding of average speed and their new conceptual understanding of acceleration, no formulas allowed. In two class periods students become proficient at talking their way through to a completed motion diagram. Later, when students are solving problems using kinematic formulas, we require that they check their results using this conceptual-plus-motion diagram approach.

Room 3

Constraints on Quantum Gravity from Astrophysics

David Mattingly

University of California-Davis

mattingly@physics.ucdavis.edu

Quantum gravity predicts that near the Planck length (10^{-35} m) the general relativistic description of spacetime breaks down. In a number of quantum gravity models, this breakdown leads to a Planck scale violation of Lorentz invariance, which is a fundamental symmetry of relativity. Due to the extreme smallness of the Planck length, such violation is very difficult to detect on earth. It does, however, produce effects that are testable using astrophysical observations. Observations of the polarization of gamma ray bursts, photons from the Crab nebula, and cosmic rays put severe limits on the violation of Lorentz invariance at the Planck scale and hence constrain a number of quantum gravity models.

Room 70

Measurement of the COR of Baseballs as a Function of Humidity

David Kagan, David Atkinson

CSU Chico, Napa High School

dkagan@csuchico.edu

Coors Field, where the Colorado Rockies play baseball, is known to be a hitter ballpark.This is not surprising to a physicist because the thinner, drier air at the high altitude of Denver will cause less drag on a fly ball. The Rockies attempted to correct for this effect by humidifying the baseballs used at these games. In principle, the balls will then have a smaller coefficient of restitution (COR) and therefore not leave the bat with as high a velocity. We have measured the COR as a function of humidity and can definitively say whether this feature of the weather is a cloud on the horizon of the National Pastime.

Room 2

Solving Differential Equations Quickly and Easily with Factorized Operators

Kurt Crowder

Los Medanos College

kurtcrowder@aol.com

Factorized operator techniques have many advantages over the standard techniques that are commonly used to solve linear differential equations. Factorized operator techniques are often easier to apply than other techniques. In fact, there are even cases where an equation can be solved by "inspection." Furthermore, it is easy to see that factorized operator techniques are related to each other, the theory is straightforward to derive, and "exceptional" cases, which plague some of the standard techniques, are easily handled. In this talk, we will explore the main ideas behind factorized operator techniques, use these ideas to derive some of the underlying theory, and we will apply the techniques to some of the more common differential equations found in physics. (...)

3:00pm, Saturday, Nov. 15, Evans Hall

Room 10

Ideas for Understanding General Relativity

Lee Loveridge

UCLA

`leecl@physics.ucla.edu`

General Relativity is usually taught at either a very elementary or very advanced level. In this talk I hope to expound on ways to teach and understand GR at a middle level. I will first present various ways to visualize the Riemann, Ricci, and Einstein tensors as well as the scalar curvature. Then I will give an illustration of how these visualizations help to understand Einstein gravity.

Room 60

Student Assessment in Physics 7 at UC Davis

Austin Calder

University of California, Davis

`calder@physics.ucdavis.edu`

In introductory science courses students pay attention to what they are tested on. In physics 7, our learning goals emphasize functional understanding and making sense of content. Students make sense by reasoning with the constructs and relationships of broadly applicable models. Consequently, our assessment items on quizzes and the final typically emphasize the application of a general model to a particular case and/or making sense of phenomena from the standpoint of a model, rather than algorithmic problem solving. The difference in performance by gender on a particular assessment is one useful window into how well that item works We also believe exam items should be authentic; i.e., they should as much as possible be the same kinds of tasks students perform in the 5-hour discussion/lab; we attempt to do this. Discussion/labs (...)

Room 9

Gamma Ray Burst Astronomy in the Classroom

Sarah Silva

Sonoma State University

`sarah@universe.sonoma.edu`

The NASA Education and Public Outreach Group at Sonoma State University will show you how to integrate the exciting topic of cosmic Gamma Ray Bursts into your grades 9-12 science and mathematics classes. We have created a science educator unit using gamma ray burst astronomy with four activities that assist with teaching basic physics and mathematics topics. This unit will be demonstrated and distributed along with other NASA goodies.

Room 3

Of Marbles & Middlemen & Monsters: A New Class of (Intermediate-Mass) Black Holes

Diane Sonya Wong

UC Berkeley

`dianew@astron.Berkeley.EDU`

In the past 2 years, intermediate-luminosity X-ray Objects (IXOs) have generated much attention. They are formally defined as non-nuclear point X-ray sources with X-ray luminosities $L_x = 10^{39}$–10^{41} erg/s. There are three points to be made here: (1) The "non-nuclear" part of the definition is important because it means that these are not normal black holes in the centers of galaxies. (2) The "point" part of the definition is important because it means that these are not simply complexes of normal objects. (3) Finally, the luminosity range of these objects is intermediate between the luminosities (10^{33}–10^{39} erg/s) of stellar mass black holes, and luminosities ($> 10^{41}$ erg/s) of supermassive black holes. Thus, a reasonable suggestion would be that IXOs are intermediate-mass black holes. However, while the formation of stellar mass and supermassive black holes is well-established, how and whether intermediate-mass black holes can be formed is not as well-studied. Thus, other models (...)

Room 70

^{209}Bi has the longest known half-life at 1.9×10^{19} years

Paul Peter Urone

California State Univ., Sacramento

`paulpeterurone@earthlink.net`

Long thought to be the heaviest stable nucleus but also long suspected to be unstable, ^{209}Bi has recently been reported to alpha decay with the longest known half-life ever measured. I will concentrate on examples suitable for undergraduate classroom use. These will include discussions of magic numbers, why ^{209}Bi should be unstable, and why it has such a long half-life. Also included will be decay equations and calculation s of decay rate. A description of the experiment in which ^{209}Bi was discovered to be radioactive and its half-life determined will also be presented.

Room 2

The Bianchi Identities and Regge Calculus

Geoffrey Kagel

Univ. of CA at Irvine (unofficial affiliation)

`gkagel@uci.edu`

The Bianchi Identities ensure the divergencelessness of the field side of Einstein's equations; these identities are similar to div(B)=0 when B is written in terms of A. Regge calculus, which breaks up space-time into 4-simplices (in four dimensions, or tetrahedrons in three dimensions), will be used, eventually, to approximate gravity in numerical simulations. An understanding of how to write the Bianchi Identities in Regge Calculus variables provides deeper insight into Regge Calculus, and hence is the topic of my research. This talk will emphasize understanding the Bianchi Identities in the continuum and understanding Regge Calculus; the form of the Bianchi Identities in Regge Calculus may be shown (but not derived) at the end of the talk, time permitting.

3:20pm, Saturday, Nov. 15, Evans Hall

Room 10

The Curious Case of Schrodinger's Relativistic Equation and Other Cautionary Tales

Richard Kidd
Diablo Valley College
`chbks@earthlink.net`

Schrodinger's relativistic fine-structure correction was perfectly correct, yet it was deemed wrong because it disagreed with Sommerfeld's accepted version. But Sommerfeld's expression was not the relativistic correction as believed! Anecdotes from the history of science illustrate the pitfalls of theory verification for would-be physicists.

Room 60

Guiding Students in the Design of a Simple Experimental Procedure

Wes Bliven
Humboldt State University
`wwb2@humboldt.edu`

A simple experimental setup will be presented which motivates students to think about techniques and sources of error in an experimental procedure. The experiment measures the specific heat of lead using digital thermometers, lead weights, water, Styrofoam cups, beakers and hotplates. The students are presented with an experimental procedure that is intentionally flawed. The students are then asked to design and carry out experiments to identify and correct the procedure. I use this experiment as an introduction to the upper division Senior Laboratory class. Despite the simplicity of experiment many students (70%) have difficulty finding the main sources of error. In addition, this experiment can be used to help students learn to apply the theoretical tools they have learned to a practical problem. (...)

Room 9

Establishing a Research-based Space Academy for High Schools

Jeffery Adkins
AAPT
`jefferyadkins@antioch.k12.ca.us`

Deer Valley High School in Antioch, California received a Specialized Secondary Program grant from the California Department of Education to establish a Space Academy at our high school. This is the first year of implementation and includes two experimental courses designed specifically for high school. A description of the grant proposal, the expected infrastructure purchases, the curriculum, and aspects relevant to student-based physics and astronomy research will be presented.

Room 3

Laser Spectroscopy of the Lithium: Oops and Redemption

William DeGraffenreid
California State University, Sacramento
`degraff@csus.edu`

In response to advances in theoretical techniques that have led to calculations of energy levels, hyperfine structure, and isotope shifts with precision comparable to those of existing experimental values, a systematic study of atomic lithium was recently started. After nearly a year of collecting data on the 3S and 4S levels of atomic lithium, and a few weeks prior to submission of some of these results to a journal for publication, a systematic complication was discovered that rendered most of our data meaningless. I will discuss our attempts to salvage the data as well as our revised approach that got us back on track.

Room 70

The What, Why and How of Radioactive Beams

Peggy McMahan
LBNL
`p_mcmahan@lbl.gov`

Why do scientists want to build an accelerator to "smash atoms" of radioactive species which only live seconds? They do if they want to understand how the elements in our universe were formed in supernovae and neutron stars, where conditions were very extreme. The nuclear reactions which took place in these extreme environments can't be studied with a garden-variety accelerator, so the nuclear science community in the U.S. is proposing the Rare Isotope Accelerator as its highest priority for new construction. This billion dollar facility would explore the nuclear properties of thousands of new isotopes of all the elements on the periodic chart. RIA won't be operational for at least ten years. In the meantime, scientists at LBNL have made and accelerated some radioactive beams of their own using the 88" Cyclotron. These include: (i) Carbon-11, which has one less neutron than stable Carbon-12 and survives for 20 minutes, (ii) Oxygen-14, with two less (...)

Room 2

Consistent Quantum Reasoning

Richard Scalettar
California State Univ., Long Beach
`discal@physics.csulb.edu`

During the last two decades, great progress has been made in our understanding of quantum theory. It is excellently summarized in the recent monographs of Robert Griffiths and Roland Omnes, the chief progenitors of these new developments. The underlying mathematical structure of classical mechanics is position and momentum phase space. That of quantum mechanics is a complex linear vector space, as formulated by Dirac and von Neumann. The differences (and similarities) in the logical interpretations have their origin in the differing mathematical structures. In classical physics, all meaningful properties of a given physical system are simultaneously discussable and propositions concerning these properties obey the familiar rules of logic. In quantum theory, certain properties are undefined and there are many incompatible families of propositions. Griffiths and Omnes recognized that, in order to avoid the so-called paradoxes of quantum theory, one must restrict (...)

3:40pm, Saturday, Nov. 15, Evans Hall

Room 10

Itinerant Electron Magnetism

Dmitriy Likhachev

Therma-Wave, Inc.

`dlikhachev@thermawave.com`

The magnetism is one of the most interesting and important areas of condensed matter physics due to a huge variety of materials with different kinds of magnetic behavior and their technological applications. In spite of the tremendous changes in the field in the last few decades, it is still possible to present some of the most significant ideas and results to a class of high school students. This talk is intended to review the basic understanding of the magnetic properties of metals and alloys in which the conduction electrons (itinerant electrons) are mainly responsible for magnetism. Magnetic properties of such materials are described starting with the free electron gas (which approximates the conduction electrons). However, this picture of free (or almost free) electrons has a limited success (...)

Room 60

Building a Trebuchet: A Fun Project-Based Learning Experience

Dominic Calabrese

Sierra College

`dcalabrese@sierracollege.edu`

The Physics Club at Sierra College recently built a trebuchet, a replica of a medieval device that launches large projectiles over great distances. The challenge and excitement of designing and building this device stimulated the interest and motivation of students and faculty across the campus. The insight, skill, and resources of students and faculty from several departments and of businesses and people from the local community were instrumental to the success of the project. In our presentation, we will illustrate the physical and engineering concepts that make the machine work as well as the collaborative aspects of the project that brought about a collegial spirit.

Room 9

Foundations & Lessons of SP3ARK: A Professional Development Project Improving Inquiry-Based Science Instruction in New York City

Frank B. Hicks, III

New York Academy of Sciences (formerly)

`frank@fbhicks.com`

From 1997-2002, the SP3ARK project at the New York Academy of Sciences worked in partnership with New York City school districts to provide professional development for middle school science teachers. The project aimed to give teachers the skills, tools, and confidence to lead inquiry-based instruction in their classrooms. During the 2001-2002 school year, SP3ARK worked with five school districts and led workshops for teachers of nearly 70% of the middle school students in Manhattan. The contact with teachers ranged from workshops that met monthly throughout the school year to sets of 2-3 half-day workshops. This talk will briefly describe SP3ARK scientific and pedagogical foundations and its workshop model. It will then discuss the major lessons learned, including organizational keys to success, the competing needs of teachers (...)

Room 3

The Blume-Capel Model — A Comparison of Standard Monte Carlo Techniques

Daniel Hurt

UC Davis

`dwhurt@ucdavis.edu`

One of the most simple models of magnetism is due to Ising: Each site of a spatial lattice has a spin, s, which can point either up or down. The energy favors ordered spin arrangements and the entropy favors randomness. Blume and Capel generalized the Ising model to allow s to not only contain the spin values; a site can now have no spin value which represents a vacancy. In this talk I will describe how the density of the vacancies affects the nature of the magnetic phase transition between ordered and disordered states. I will also look at the standard Monte Carlo Techniques such as Metropolis and compare them to the new algorithm proposed by Wang and Landau.

Room 70

Electron Paramagnetic Resonance Applications in Solid State Physics

Saul Oseroff

San Diego State University

`soseroff@sciences.sdsu.edu`

A brief description of the technique will be presented. Electron Paramagnetic Resonance has been particularly fruitful in Condensed Matter Physics. Its contributions in systems including insulators, semiconductors and metals will be addressed.

Room 2

What is the Universe made of?

Jack Sarfatti

American Physical Society

`sarfatti@pacbell.net`

”The Question is: What is The Question?” said John Archibald Wheeler. I suggest that physicists have not been asking the correct question of Nature when it comes to the ”dark matter” component that is almost 1/4 of the stuff of the large-scale universe. I predict that experiments to detect real dark matter particles like the SUSY partner ”neutralino” will fail just like the Michelson-Morley experiment failed to show the motion of the Earth through the “aether”. I propose that gravitating “dark matter” with positive zero point fluctuation pressure is also a form of exotic vacuum on the same footing as “dark energy” with negative zero point pressure that is almost 3/4 of the stuff of the universe on a large scale. That is, both have w = -1 although dark matter appears to the distant observer to have w = 0. This new idea also explains some mysteries of small scale physics like the stability of the electron in the face of (...)

4:00pm, Saturday, Nov. 15, Evans Hall		
Room 10	**Room 60**	**Room 9**
Highland Games: The Caber Toss Scott Perry American River College skparc@comcast.net The caber toss is mentioned in history as early as the 16th Century. A caber is the trunk of a tree that has been cut and trimmed so that one end is bigger than the other. A caber length is typically around 20 feet and can weigh as much as 180 pounds. The object is to lift the caber to a vertical position and then toss it end over end toward a castle. The physics and techniques involved in the caber toss will be discussed along with some rather arcane units of measure. The results of a video analysis of a nationally ranked, master caber tosser will be presented.	**Physics Experiments Using a Battery-Operated Toy Car*** Xueli Zou, Stephen Cheng, Eva Kozachenko California State University, Chico xzou@csuchico.edu This talk will present some experiments using a battery-operated toy car. Those experiments can be used in college introductory and high school physics laboratories. Detailed designs and data of the experiments will be shared. *Supported in part by NSF DUE #0088906 and DUE #0242845	**Physics First Using the Modeling Approach** Brenda Royce, Brad Huff Cal. State Fresno brendar@csufresno.edu At University High School, a new, charter high school located on the Fresno State campus, the Modeling Approach developed by David Hestenes and the late Malcolm Wells at Arizona State University is successfully introducing 9th graders to the concepts of physics. Quantitative work is supported by the students' taking algebra II concurrently. The sequence of science courses continues with chemistry using Modeling and college level biology and geology. Standardized testing gives encouraging evidence that our students' thinking skills and understanding of experimental processes are above the norm. Group interactions and student presentation skills are greatly enhanced with this approach. This talk is for you, if you are considering moving physics to grade 9 or are unfamiliar with the methods of Conceptual Modeling.
Room 3	**Room 70**	**Room 2**
Phase Transitions and Random Matrices Richard T. Scalettar University of California, Davis scalettar@physics.ucdavis.edu The study of the eigenvalues of random matrices in physics dates back to Wigner, who was modeling nuclear energy levels, and Dyson, who was trying to understand the vibration spectrum of disordered solids. Amazingly, matrices with random matrix elements can have eigenvalue distributions which are far from random. In this talk, I will briefly review the eigenvalue patterns of several types of random matrices in which the matrix elements are chosen independently of each other. Then I will describe how those patterns shift when the matrix elements 'interact' with each other, that is, their probability distribution is not independent. In this interacting case, 'phase transitions' can occur in which the distribution of matrix elements abruptly changes form.	**Diode Laser with External Grating-Based Cavity** Cristian Heredia Cal Poly San Luis Obispo, Physics cheredia@calpoly.edu We have developed an external cavity for a diode laser via the Littrow configuration. In conjunction with this configuration and varying diode temperature we were able to fine tune a 785 nm diode laser down to 780 nm. The laser output has been diagnosed at several stages using a real-time, computer driven spectrometer, providing insight into the operation of both a free-running and stabilized diode laser. At this wavelength we were able to observe the fluorescence of the Rb D line at 780 nm.	**Einstein's Last Question - What Is an Electron?** Milo Wolff Technotran Press - Physics and Astronomy milo.wolff@att.net In his later years Einstein was asked his thoughts about the huge numbers of short-lived heavy articles (e.g., kaons, pions, quarks, mesons, etc.) found using high-energy accelerators and enormous amounts of time and money. The physicists thought these were important basic matter and wanted to know what Einstein thought of their work. Einstein was a careful thinker and not given to theatrics, so he was very serious when he replied, he would just like to know what an electron is. Why did he say this? His answer implied, contrary to popular thinking, that the pedestrian electron, known since Greek times, was more important to science than the billions of dollars spent on accelerators. Little attention was paid to his remark. High-energy physics became a growth industry. But Einstein saw the electron as the leading player in the universe, as did any careful scientist, because most activity of the Universe is dominated by energy transfers attributed to the electron. Neither Einstein nor anyone else understood (...)

4:20pm, Saturday, Nov. 15, Evans Hall

Room 10

Room 60

Room 9

Data Analysis Strategies of Students in a Millikan Simulation Experiment

Bryan Cooley

eeps media

`bryancooley@mindspring.com`

Students in several different classrooms were asked to determine the mass of a penny by measuring the mass of several film canisters filled with an unknown number of pennies. By using Fathom^{TM}, a new data analysis program, students were able to use multiple strategies to tackle this problem. The student strategies will be examined along with several other issues the lab brought up including: prescripted vs. unscripted data analysis, multiple solutions vs. one correct answer, multiple representations of the solution, and data uncertainty and accuracy. The students' fluency with data anlysis was explored and challenged by this non-traditional lab.

Room 3

Superluminal Helical Models for the Electron and Photon

Richard Gauthier

Sonoma County Office of Education

`rgauthier@qwickconnect.net`

Quantum wave-particle models of the electron and photon are proposed which are composed of sheets of electric charge moving faster than light and having closed (electron) and open (photon) helical internal paths for these moving sheets of charge. For the photon the forward helical angle is found to be 45 degrees and the charged sheet's speed is 1.414 c for all wavelengths. Its net electric charge is zero. The maximum speed of the electron model's charged sheet is 2.797 c. The electron model, a self-intersecting torus, is set to have the mass, charge, spin and first order ($g = 2$) magnetic moment of an electron. The electron's charged sheet generates the electron's deBroglie wavelength through internal self-interf erence and Doppler shifting of the circulating photon-like object composing the electron. The electron model predicts two distinct symmetrical varieties of the electron (and two varieties of the positron). The electron model's size contracts with velocity so that its relativistic size is consistent with high energy scattering results (at about 200 GeV) that set a maximum size of an electron at this energy to be about 10^{-18} m.

Room 70

Room 2